

Building 643, Full Scale (30- by 60-Foot) Tunnel NASA LaRC

When it was completed in 1929, the first National Advisory Committee for Aeronautics (NACA) wind tunnel complex at Langley was regarded as one of the best test facilities in the world. Yet, because of its relatively small size, the variable density tunnel could only employ scaled-down aircraft models, a limitation that created a number of testing deficiencies. For example, engineers could not adequately assess how rotating propellers affected aircraft control, or quantify the interference effects—or “drag penalties”—of various aircraft components such as external struts, wheels, and engine-cooling installations. It was always possible to test actual aircraft in flight, but variations in atmospheric conditions required numerous flight checks to average the results. Given the current state of testing technology, the only alternative was to build a wind tunnel large enough to accommodate full-sized aircraft.

Recognizing the importance of conducting full-scale aircraft investigations under controlled conditions, NACA authorized the construction of the Full Scale Tunnel (FST) at Langley in February 1929. Smith J. DeFrance led the design team, which also included Abraham Silverstein, Clinton H. Dearborn, and Harry J. Goett. The timing of the project was fortunate: the initial appropriation of \$900,000 was made before the onset of the Depression; and by the time work began in the spring of 1930, labor and material costs had fallen, and the project directors could draw from a large pool of unemployed engineers.

Work on the FST proceeded rapidly, and it was completed and ready for operation in May 1931, when it hosted the Sixth Annual Aircraft Engineering Conference. The largest wind tunnel in the world at that time, the FST had a unique design, with the building’s steel framework visible on the exterior of the building. The enormous facility measured 434 feet long, 222 feet wide, and 90 feet high, and immediately became a recognizable landmark at Langley. The test section measured 30 feet high by 60 feet wide (hence its alternate name), and allowed the installation of aircraft with wingspans up to 40 feet. The tunnel was powered by two propellers, each driven by a 4,000-horsepower electric motor, which could circulate air through the test section as speeds between 25 and 118 mph. The air circuit was of the double-return type, in which the airflow from the propellers was split right and left into two streams, doubling back between the test section and the building’s walls, then reuniting before entering the throat of the test section.

Early testing in the FST indicated unexpectedly high performance penalties from external aircraft components, prompting the government to send a steady stream of military aircraft to Langley for “drag cleanup tests.” But the true value of the FST was realized when the U.S. entered World War II. The FST operated around the clock, seven days a week, during the war years. Virtually every high-performance fighter aircraft was evaluated in the FST, allowing for countless design improvements that gave American pilots a critical edge in combat. A variety of other objects also were tested in the FST during its operational lifetime, including dirigibles, submarines, radar antennae, gliding

parachutes, inflatable airplanes, free-flying models, and even another wind tunnel complex.

Although the performance of jet aircraft in the postwar period outpaced the relatively low speed capabilities of the FST, the facility remained an important test facility for NACA and its successor, the National Aeronautics and Space Administration (NASA). Upgrades in 1977 and 1984 improved the operation of the electric fan motors, and allowed the facility to continue testing aircraft whose technology and performance could not be envisioned in the biplane era in which it was built. The wing shapes and airfoil sections of transonic and supersonic airplanes, which often exhibited poor low speed characteristics, were effectively tested in the FST. Free-flight testing of models was also conducted, allowing engineers to identify weak design characteristics in the early stages of development. Numerous modern aircraft were tested in the FST, including the Harrier Vertical Takeoff and Landing (VTOL) fighter, the F-16 Fighting Falcon, the American supersonic transport, the X-29A forward swept wing experimental fighter, the Lunar Landing Test Vehicle, and the Space Shuttle.

The historical significance of the FST and its many contributions to aerospace technology were recognized when it was designated a National Historic Landmark in 1985. The oldest operating wind tunnel at Langley when NASA finally decommissioned it in October 1995, the facility gained a new lease on life when it was transferred to Old Dominion University (ODU) under the terms an innovative privatization program. ODU began operations at the FST in October 1996, providing engineering research facilities for graduate students and private customers in the field of aircraft and automotive transportation.

REFERENCES

Baals, Donald D. and William R. Corliss,

1981 *Wind Tunnels of NASA*. Washington, D.C.: National Aeronautics and Space Administration, 1981.

Butowsky, Harry A.

1984a *Man in Space: National Historic Landmark Theme Study*. National Park Service, Department of the Interior, Washington, D.C.

1984b National Register of Historic Places Inventory-Nomination Form, Full Scale Tunnel. National Park Service, Department of the Interior, Washington, D.C.

Historic American Engineering Record

1995 NASA Langley Research Center, Full-Scale Wind Tunnel, VA-118-A. National Park Service, U.S. Department of the Interior, Washington, D.C.


National Advisory Committee for Aeronautics (NACA)

1957 *Characteristics of Nine Research Wind Tunnels of the Langley Aeronautical Laboratory*. Washington, D.C.

Old Dominion University

2004 Langley Full-Scale Tunnel Website, <www.lfst.com>.




 Full Scale Wind Tunnel
NASA Langley Research Center

10/31/1930

Image # EL-1999-00405




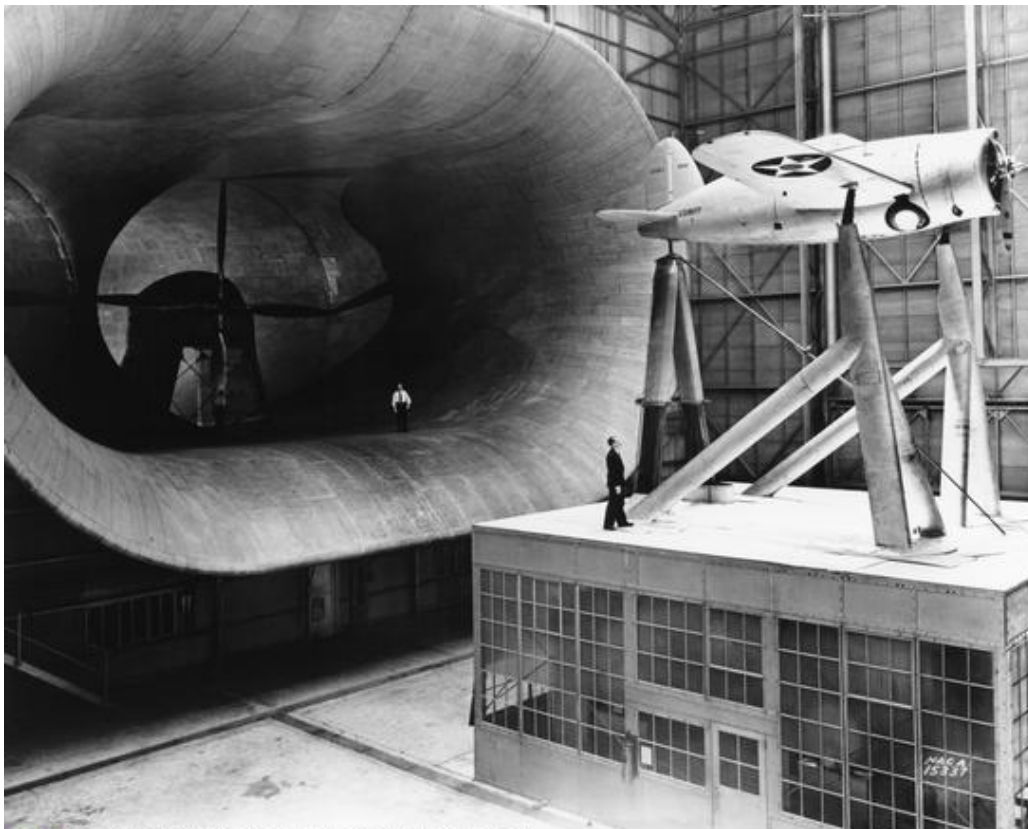
 Aircraft Engineering Conference 1934 – Full Scale Tunnel
NASA Langley Research Center


5/23/1934

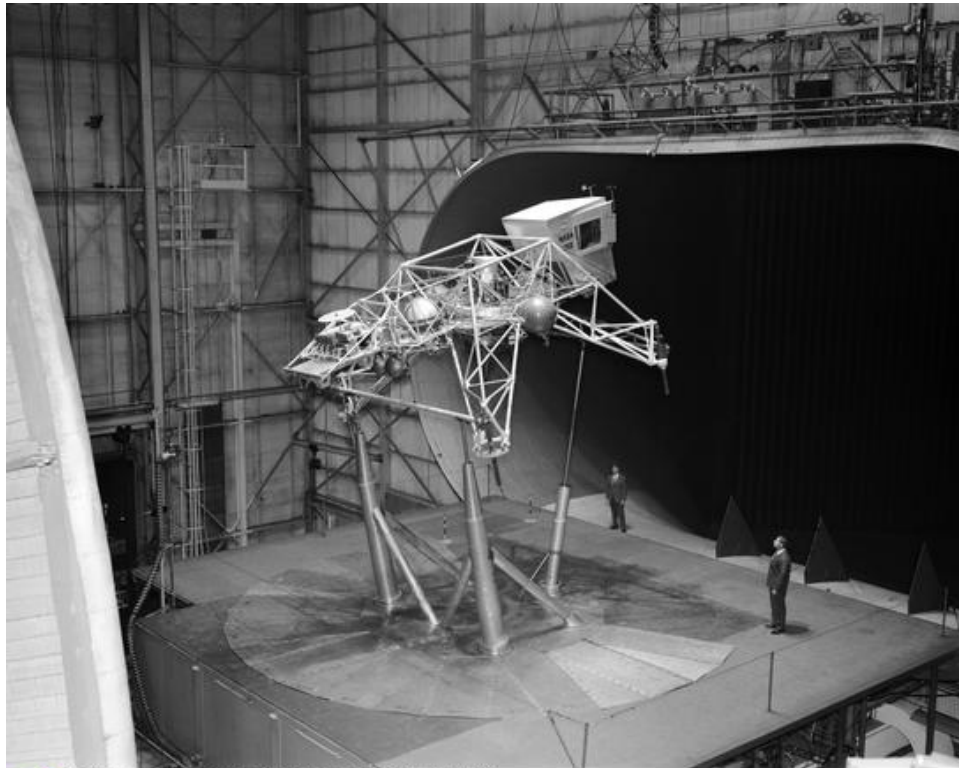
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 Curtiss SB2C Dive Bomber in Full Scale Tunnel
 NASA Langley Research Center 1/18/1946 Image # EL-2001-00383




 Brewster Buffalo in Full Scale Wind Tunnel
 NASA Langley Research Center 5/2/1938 Image # EL-2001-00379



 Bell Lunar Landing Training Vehicle (LLTV)
NASA Langley Research Center 1/16/1969 Image # EL-2000-00449



 AST Model In Full Scale Wind Tunnel
NASA Langley Research Center 1/17/1975 Image # EL-1996-00117

Plan and elevation sketch of the Langley full-scale tunnel.

